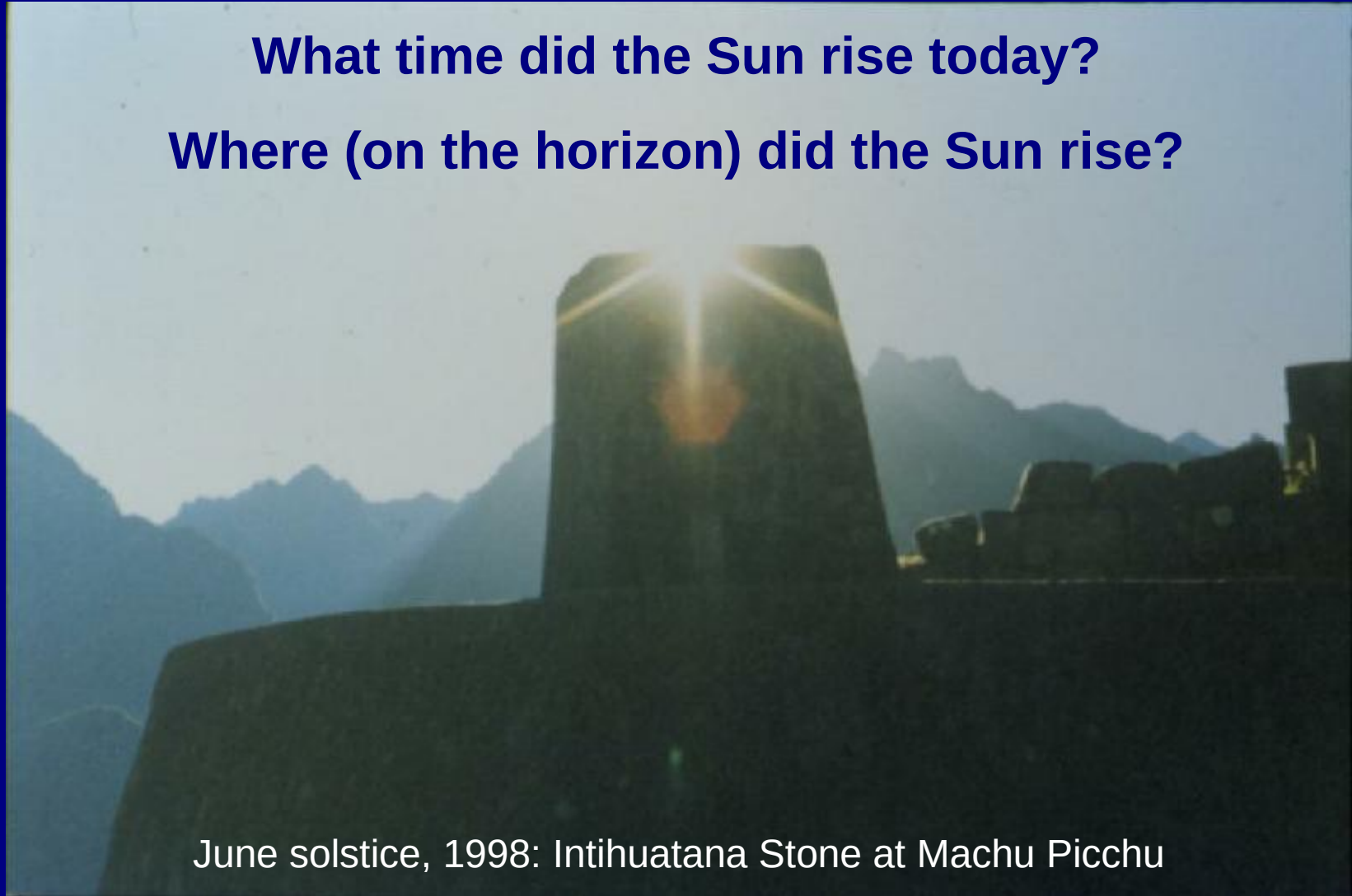


# The Sun in Time: How and Why the Sun Has Affected Cultures

**What time did the Sun rise today?**

**Where (on the horizon) did the Sun rise?**



June solstice, 1998: Intihuatana Stone at Machu Picchu

Mitzi Adams, M.S.  
Heliophysics and Planetary Group  
NASA/MSFC  
June 9, 2016



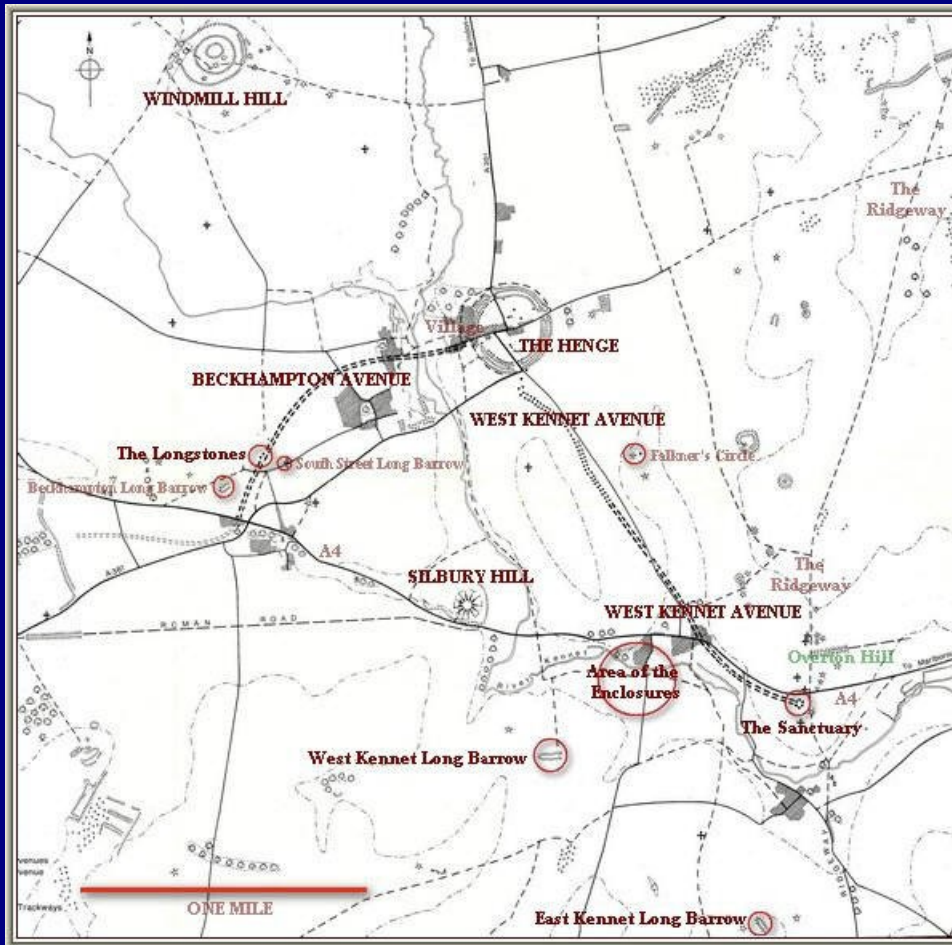
# Observing the Sun in Years Past





# Observing the Sun in Years Past – Avebury





The area of the circle is about 28.5 acres,  
the circumference is approximately 0.8 mi..

The stone circle of Stonehenge would fit into the  
outer stone circle at Avebury around 130 times.

from <http://www.avebury-web.co.uk/>



Silbury Hill



W. Kennet Longbarrow (c. 4000 - 2400 BCE)



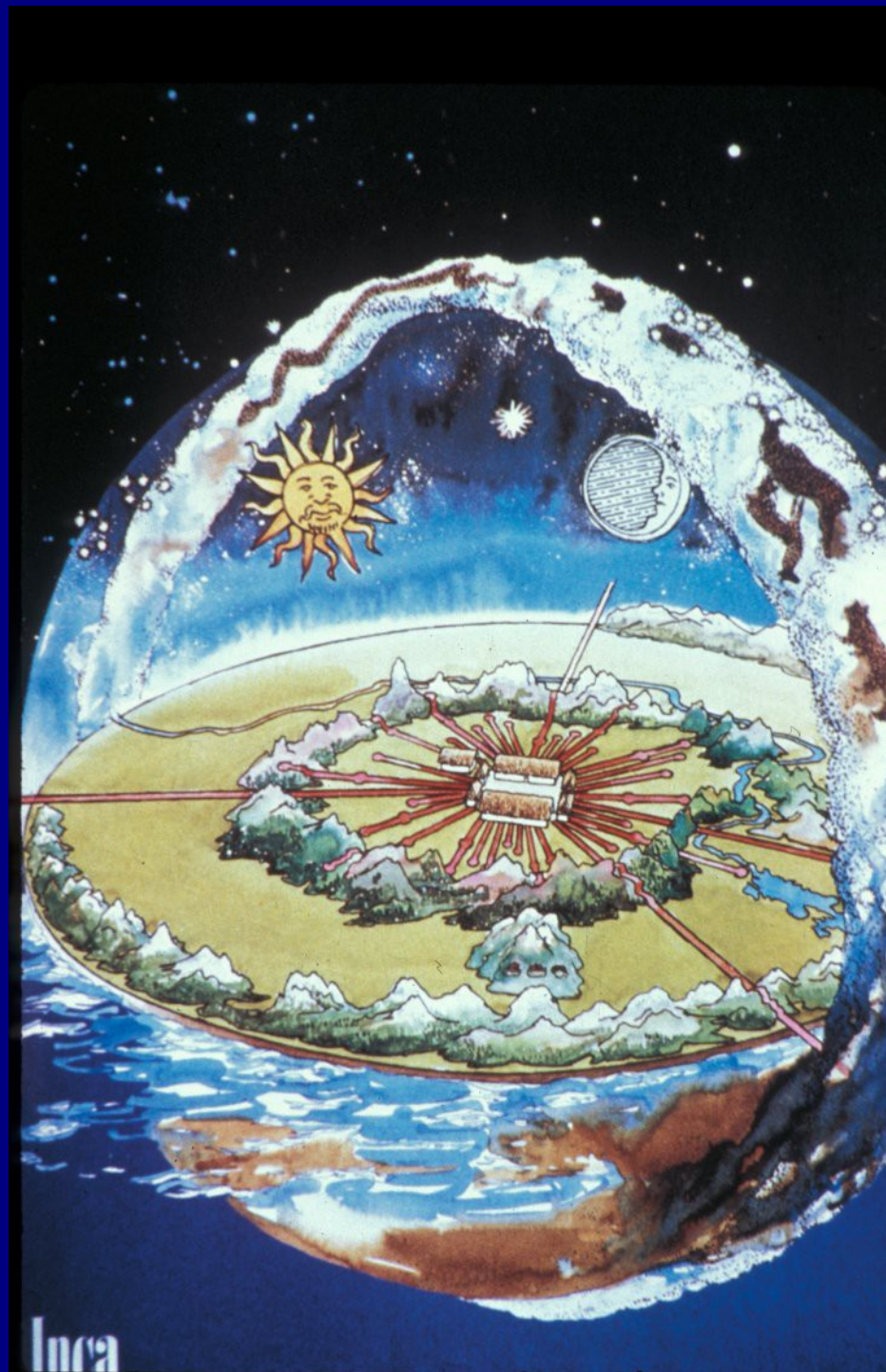




# Observing the Sun in Peru

Only about 500 - 600 years ago  
c. 1500







# Cuzco



# Chincheró













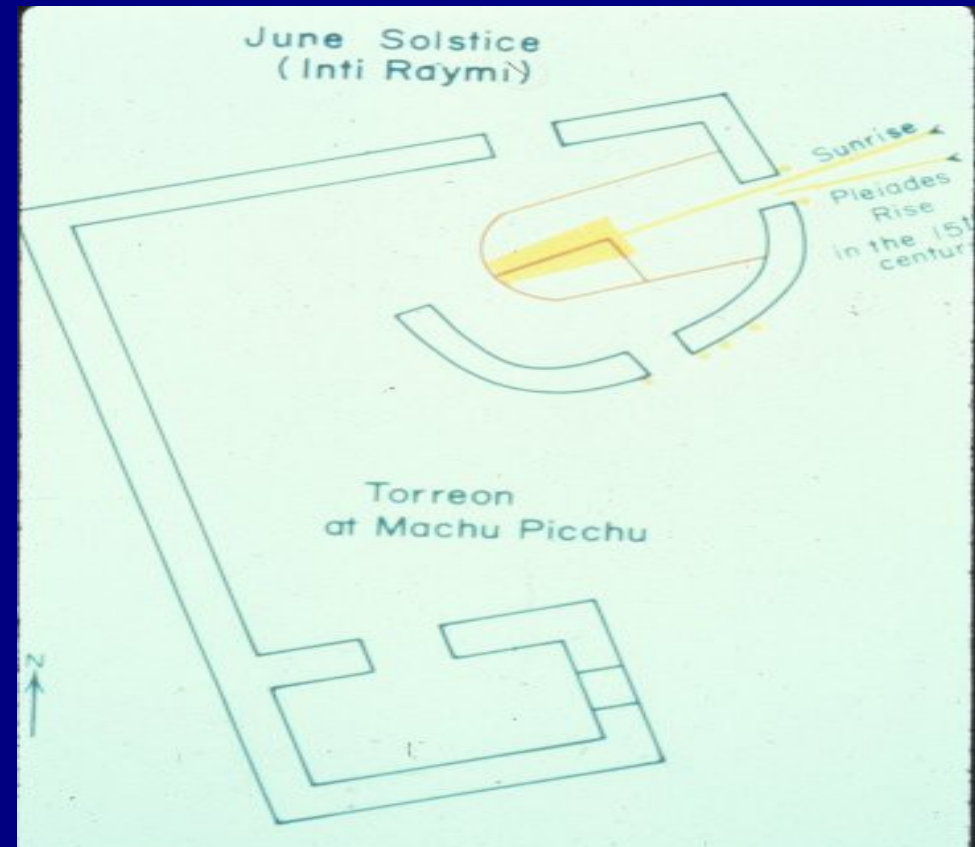
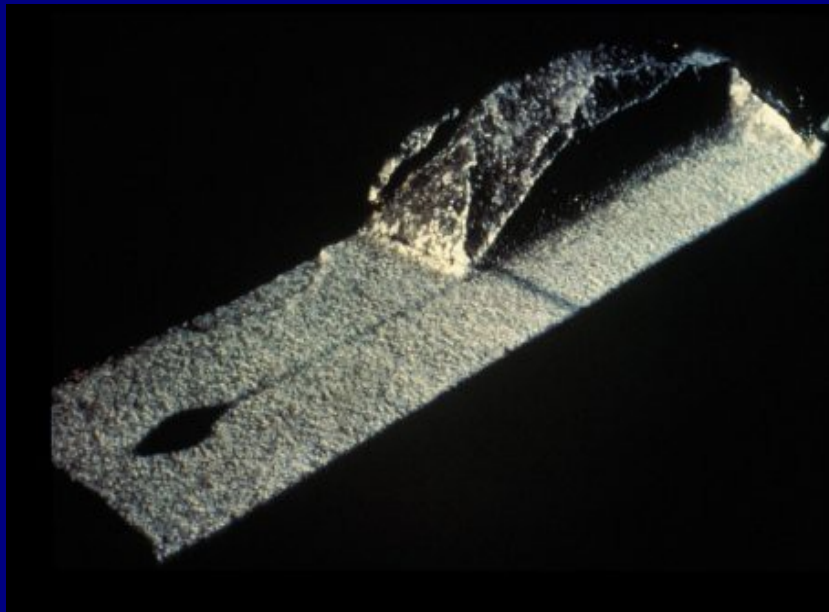




# Torreón









# Intihuatana





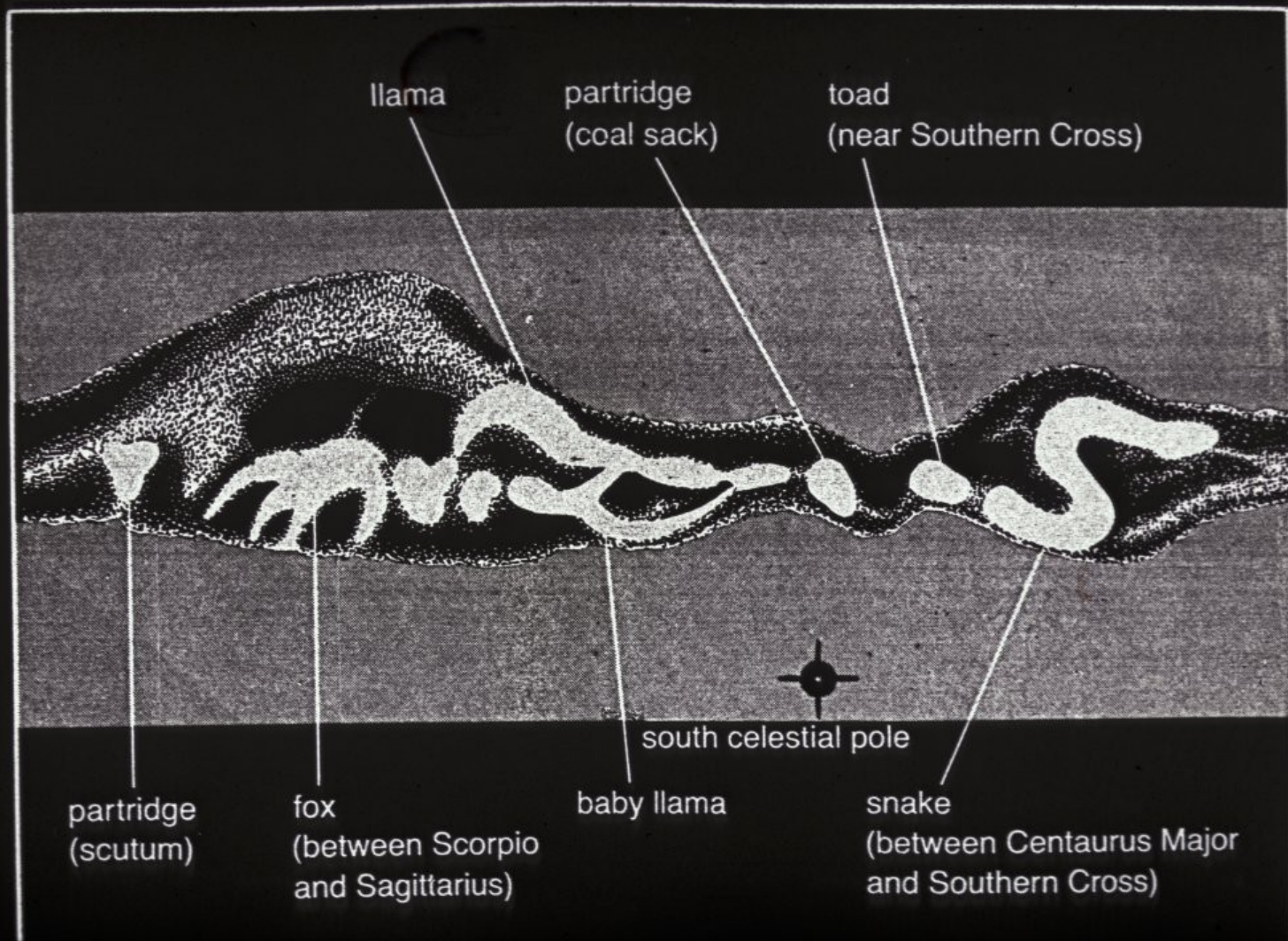




# Down in the Jungle: Cacao, Cashews





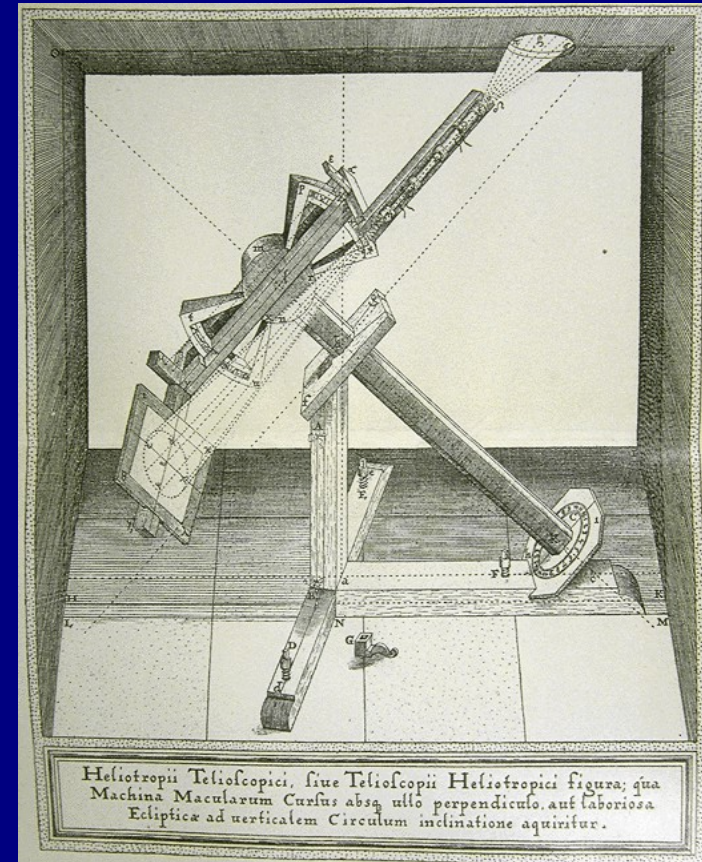
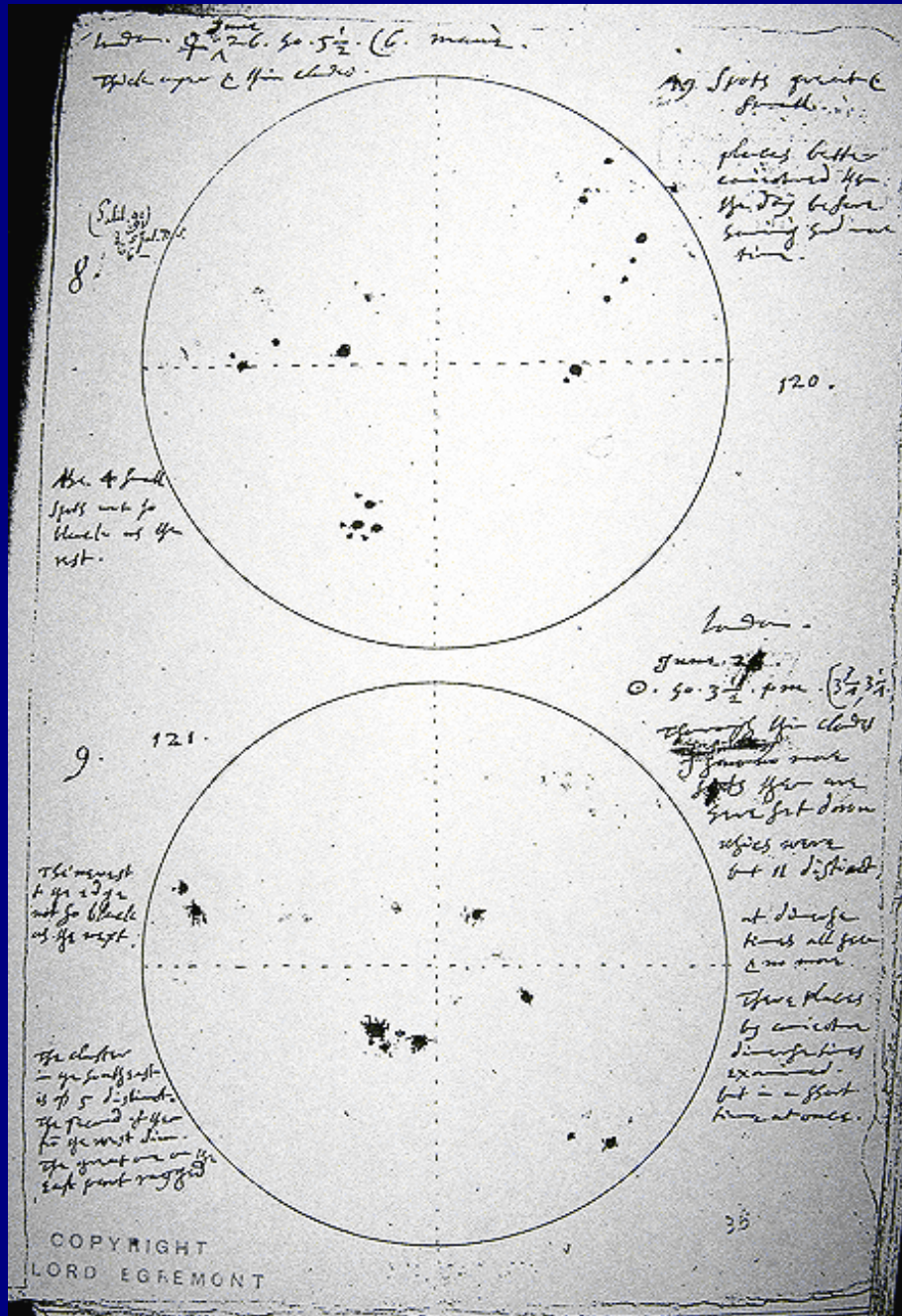




Meanwhile in Europe, c. 1610...

# Galileo Galilei, Christoph Scheiner, Thomas Harriot

These three began to use the telescope to study the Sun using a telescope. Scheiner's telescope is below.



Thomas Harriot's drawings,

from

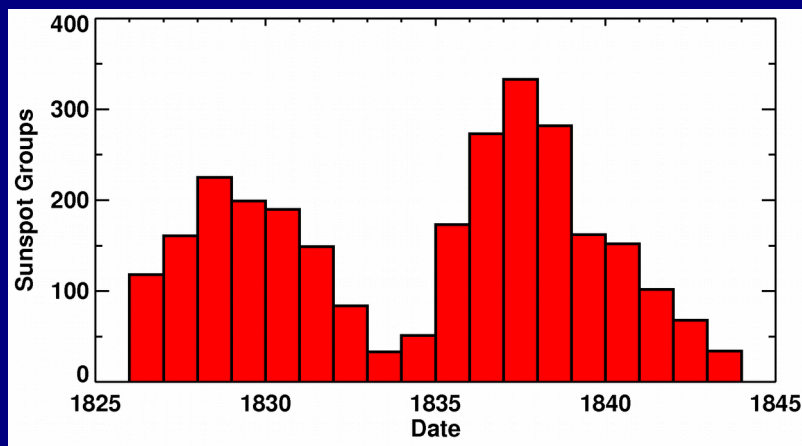
<http://galileo.rice.edu/sci/observations/sunspots.html>



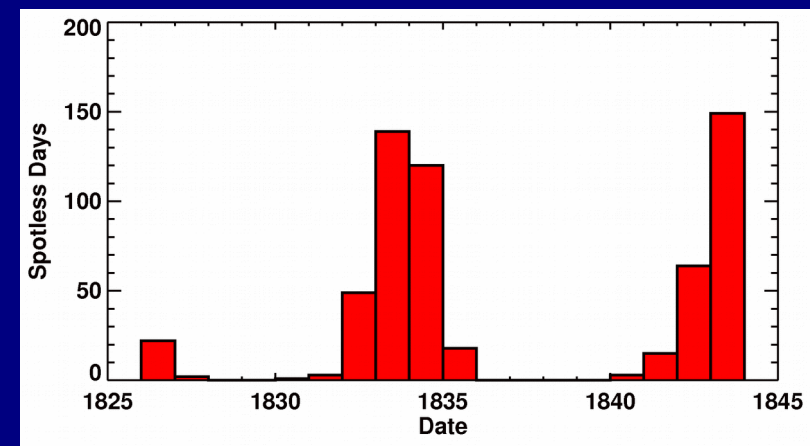
# Sunspot Cycle Discovery

~ 230 years after Galileo, Heinrich Schwabe, an amateur astronomer in Dessau, Germany, discovered that the number of sunspot groups and the number of days without sunspots increased and decreased in cycles of about 10-years.

Schwabe's data for 1826 to 1843



Number of Sunspot Groups per Year



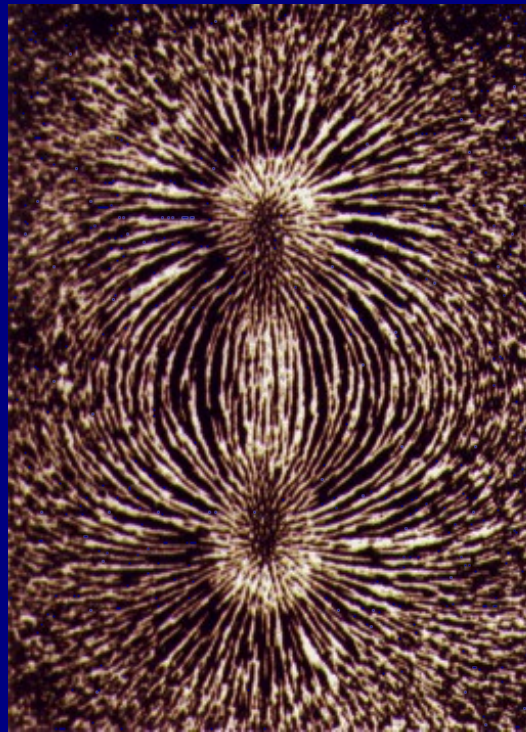
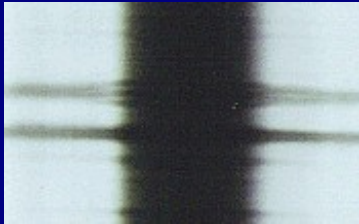
Number of Spotless Days



# Measuring Magnetic Fields



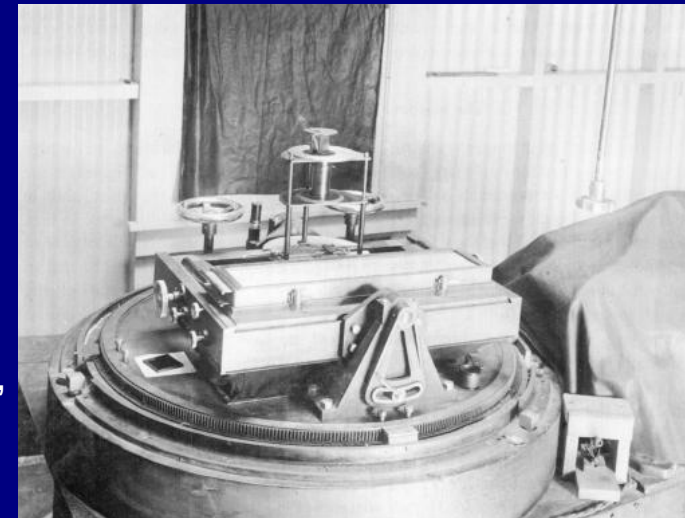
Fraunhofer, early 1800s



Zeeman, 1886

George Ellery Hale, early 1900s

30 ft spectrograph at 60 ft telescope,  
Solar Physics, vol. 100, 1985.  
1985SoPh..100..171H









# Observing the Sun Today

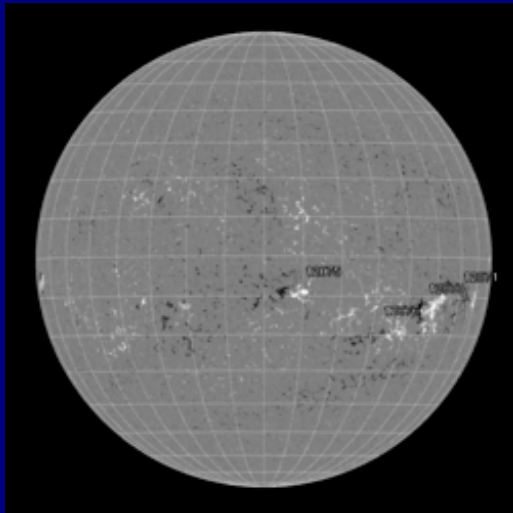


The Solar Dynamics Observatory

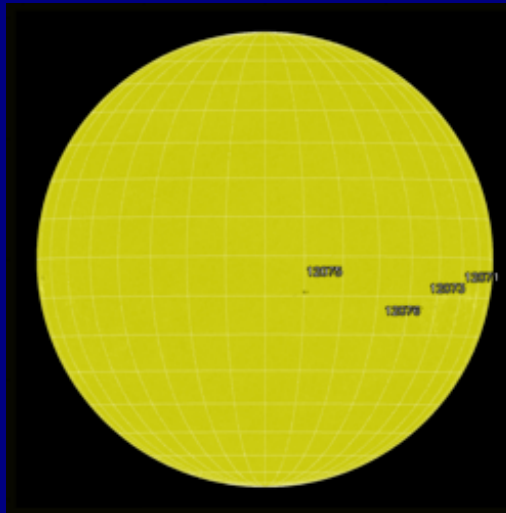


# SDO Wavelength Samples

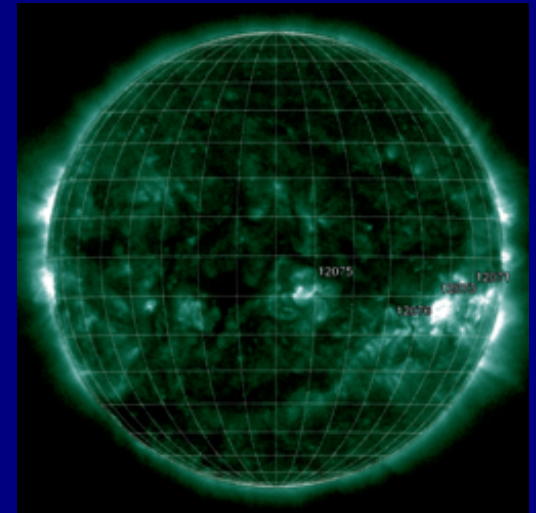
May 30, 2014



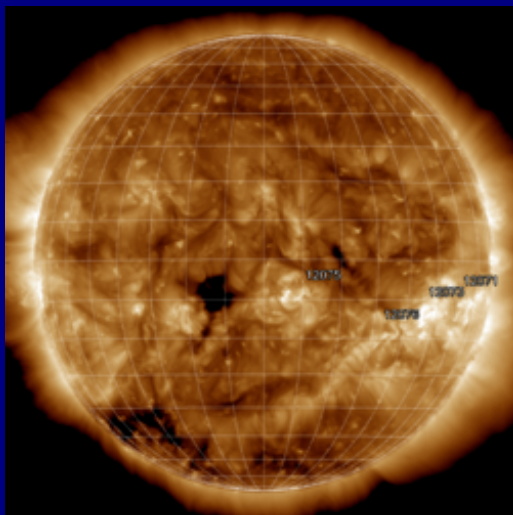
HMI



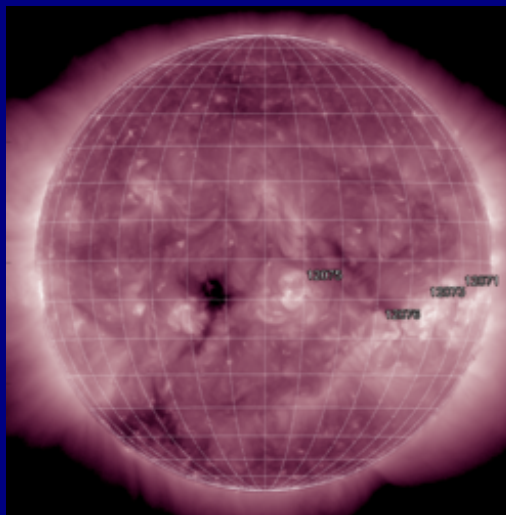
HMI - 6173 Å



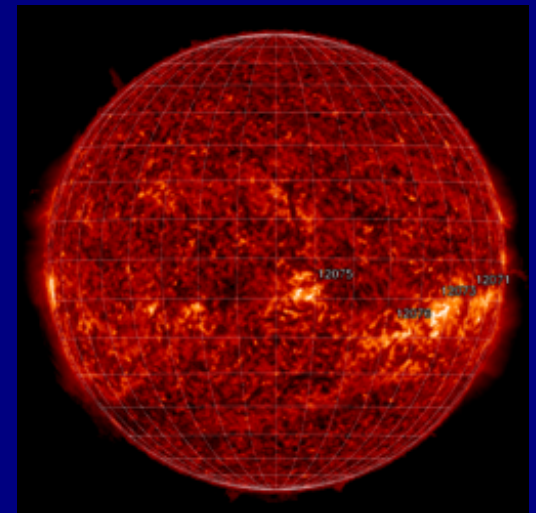
AIA - 94 Å



AIA - 193 Å



AIA - 211 Å



AIA - 304 Å